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THE POTENTIAL OF SCIENTIFIC AND TECHNICAL DOCUMENT  
REFERRAL AND RETRIEVAL TO THE PHOTOGRAMMETRIST

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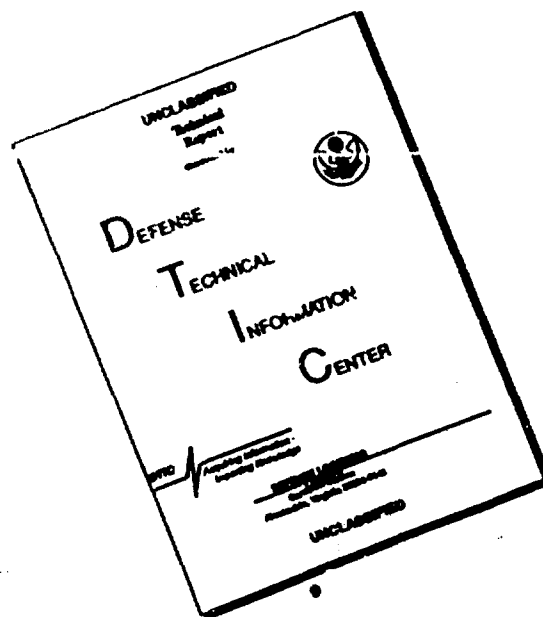
July 1967

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St. Louis, Missouri 63118

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INTRODUCTION:

In the February 1967 issue of The Airman, the official magazine of the US Air Force, a challenge was made for wise management of the fallout of the great mass of scientific and technical data resulting from the well know "information explosion." The challenge was not unexpected and this condition has been under study at ACIC for some time, particularly as it applies to developments in mapping and charting. If one considers the 830,000 reports of all subjects on file at one referral organization, a certain portion applicable to the science of photogrammetry, there is a possible solution to the problem of being aware of new developments and still remaining on-the-job. Add to this the fact that there are several other referral services and the potential of this data is increased. The problem still remains of how to present this mass of data, reports, developments and conclusions to the various levels of the industry. This problem is directly related to maintaining the state-of-the-art by operators and technicians as well as management to avoid the so-called obsolescence of ideas in five years.

In December 1966, a random survey was conducted of 40 persons at ACIC. The purpose was to determine the level of understanding and use of scientific and technical documents in their phase of the work. The results indicated a majority of those surveyed were making an effort to screen and use various abstract publication. However, the volume and

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Presented at the 1967 St. Louis Semi-Annual Convention of the American Society of Photogrammetry and Mid-Year Convention of the American Congress of Surveying and Mapping, St. Louis, Mo., 2-5 Oct. 1967. The views expressed herein are those of the author and do not necessarily reflect the views of the U.S. Air Force or Department of Defense.

scope of the available materials prohibited the successful integration of these publications throughout the production system. A trend was noted which indicated the documents were actually beginning to receive less attention despite an increase in the number available. The survey was expanded into a study of the application and impact of referral and retrieval systems into certain technical and production areas of the Center. This paper is a report of the results to date. Basically, we have defined the potential of these automated systems particularly as related to the photogrammetric field.

#### THE SCIENTIFIC AND TECHNICAL INFORMATION PROGRAM

The Air Force has made provisions for responsibility for the transfer of information under the Scientific and Technical Information (STINFO) Program and outlined procedures for a centralized documentation program. This program does not specifically relate to the potential which we investigated but it does designate a STINFO Program Officer whose duties include promotion of the use of the DDG, technical libraries, and information centers by REQUIRING the project scientist or engineer to use the available literature in their projects and avoid duplication of effort.

Despite these plans and directives, there is obviously a group as indicated by our sampling who have not been able to develop the concepts of document referral and retrieval as a potential source of information in the field of photogrammetry. Therefore a more detailed examination was believed necessary.

## SCIENTIFIC AND TECHNICAL ABSTRACTING SERVICES

First and foremost, the results of various studies, tests, programs, developments, etc., are normally documented. Many of these are in conjunction with some sponsored activity by various government agencies. Others are reports of activities in various research organizations. Abstracts of these reports are consolidated by certain abstracting services, coded by subject matter, cross referenced, and assigned a report number. Comprehensive abstract and indexing journals are then regularly published. Those services considered in our study were, as shown in Fig. 1, the Defense Documentation Center (DDC), the National Aeronautics and Space Administration, Clearinghouse for Federal Scientific and Technical Information, and the American Institute of Aeronautics and Astronautics. These publish at regular intervals a journal or journals with abstracts of those reports obtained during that time period, their availability, author, etc. (Fig. 2). In addition all publish a computer derived index listing all documents by subject matter (or category), corporate source, author, report/ accession number and accession/report number. These listings or cataloging represent the latest available data and also the form of specialization that makes this information potentially useful to the photogrammetrist. What the user can do with these sources of data was the subject of the next phase of our investigation. It must be understood at this point that the reports noted in the indexes are NOT just for use in R&D but are the fruits of the R&D effort.

## ABSTRACTING AND INDEXING SERVICES CONSIDERED IN STUDY

### Scientific and Technical Reports

National Aeronautics and Space Administration  
Scientific and Technical Information Division  
Washington, D.C. 20546

Defense Documentation Center  
Defense Supply Agency  
Alexandria, Virginia 22314

Clearinghouse for Federal Scientific and Technical Information  
U.S. Department of Commerce  
Springfield, Virginia 22151

### Published Literature

American Institute of Aeronautics and Astronautics, Inc.  
Technical Information Service  
750 Third Avenue New York, N.Y. 10017

Figure 1

## EXAMPLES OF VARIOUS CATALOGS AND JOURNALS



Figure 2

Fig. 3, 4, 5, 6 and 7 are representative of such document abstracts, as duplicated for our file.

The scope of the reports encompasses all forms of science and technology from aeronautics to space technology; from cost effectiveness to mapping; from astronomy to quantum theory. Therefore the question now becomes one of knowing if there are reports related to photogrammetry, and how to get them. At ACIC, catalogs are received by the Technical Library and are screened by library personnel for subjects known to be of general interest. They are then routed to interested offices for their review.

#### USE OF THE AUTOMATED ABSTRACT DATA:

In the tests conducted, it was found impractical to randomly scan these indexes and abstracts at office or departmental level. Over the period of one year, 77 index categories were determined to be applicable to the photogrammetric mapping/charting effort (Fig. 8). These selected categories were scanned in every issue and when a subject was found which was relevant, the abstract was read. When deemed applicable or pertinent, copy was made of the abstract. Reports which fulfilled an immediate need were ordered thru the Technical Library. This procedure served three purposes: It gave an insight into the categories to be reviewed; it provided a source for immediate solution to work related problems; and it provided the start of a specialized library of abstracts. This was not strictly a library-type function or an easy one-glance project. One must consider the complex

STAR  
8 Jan 67

AD- 638750 Raytheon Co., Alexandria, Va. Autometric Operation  
N67- 10993  
MULTIPLE STATION ANALYTICAL TRIANGULATION PROGRAM  
Final Technical Report

F.J. Doyle Dec 65 164p. refs Contract No. DA-  
44-009-AMC-741 (X)

The report describes the development and testing of a comprehensive computer program for the simultaneous aerotriangulation of a large block of photographs. The program consists of five principal parts: (1) Comparator observations preprocessor (2) Photo coordinate correction routine; (3) Aerotriangulation and pass point intersection; (4) Analysis of results; and (5) Error propagation. Part 1 is a separate program to reduce mono-comparator or stereo-comparator observations to a format acceptable for computation. Parts 2, 3, 4, and 5 are combined into one efficient program which permits a wide variety of options in the handling of the data. Sufficient tests have been run to demonstrate that the formulation is valid and not restricted by operation at any latitude or longitude on the earth.

Figure 3

TAB  
15 Dec 66

AD- 641386 Ballistic Research Labs., Aberdeen Proving Ground, Md.  
N67- 15068  
BRLESC FORTRAN II COMPUTER PROGRAMS FOR ANALYTICAL SOLUTIONS OF  
THE GENERAL PROBLEM OF PHOTOGRAMMETRY

Lila M. Butler Jul 66 149p. Report No. BRL-MR-1769  
Proj. RDT/E-1P523861A286 Unclassified Report

An analytical treatment of the general problem of photogrammetry using the Schmid method for the Single Camera Orientation, the Single Model Orientation and the Strip Triangulation have been programmed in BRLESC Fortran II. Slight modifications have been made in the Single Camera and Single Model programs for the computation of individual mean errors of unit weight for plate coordinates and known point coordinates. Input, output operating instructions and test runs are provided for the various programs. All these Fortran programs follow the flow diagrams for the Forast programs which are found in the reports mentioned in the abstracts of this report. All input data are compatible.



TAB  
1 Dec 66

AD- 641276 Institute of Modern Languages, Inc., Wash. D.C.  
N67- 19680

PHOTOGRAMMETRIC PLOTTING INSTRUMENTS

M. Shanek Oct 66 16p. Contract DA-44-009-AMC-  
1563(T); Project DA-4A-635101D855 TT 66-62542;  
T-1878-66 Unclassified Report

The instruments described include the Stereo-trigomat equipped with a differential transposing device, the Universal Plotting instrument used in precise aerial triangulation, graphic and numerical plotting and in achieving transposed photos of a hilly terrain, and the Analytical Plotting instrument, AP-C.

Figure 5

STAR  
23 July 66

N66- 25635 International Training Center for Aerial Survey  
Delft (Netherlands)

ON THE ACCURACY OF AEROTRIANGULATION WITH CONVERGENT PHOTOGRAPHY

I. Hadem 1965 45p. refs. ITS Ser., A, No. 34

The use of aerial triangulation in convergent photography is discussed; and the influences of inner orientation errors on single models are compared with influences of observational errors in parallaxes and coordinates, some general considerations concerning propagation of errors in aerotriangulation are reviewed and numerical examples of various errors are presented. A comparison is made between two types of convergent photography and wide angle vertical photography. It is concluded that the smallest closing errors occur in wide angle convergent photography but there is no clear difference between normal angle convergent and wide angle vertical photography.

TAB  
1 Feb 67

AD-644065 Foreign Technology Division, Wright-Patterson AFB, Ohio

OPTICS OF PHOTOGRAPHIC AND AEROPHOTOGRAMMETRIC INSTRUMENTS

L.S. Urmakher 29 Jul 66 32p. Rept No. FTD-HT-66-334  
TT 67-60305 Unclassified Report

Unedited rough draft translation of mono. Optika Fotograficheskikh Aerofotogrammetricheskikh Priborov, Moscow 1965 pl70-95.

Descriptors: Camera lenses, USSR; Photographic equipment;  
Cameras; Aerial photography; Optical equipment components;  
Camera components + accessories; Photomicrography.

Contents: Objectives for ground photography; Objectives for  
aerial photography; Objectives for reproduction; Optical  
systems of instruments for photomacrography and photomicrography.

Figure 7

# INDEX CATEGORIES- PHOTOGRAMMETRY/CHARTING

111	Aerial Cameras	1311	Mapping
112	Aerial Photographs	1312	Map (s)
113	Aerial Photography	1331	Military Intelligence
114	Aerial Reconnaissance	1511	Optical Detection
121	Analytical Photogrammetry	1512	Optical Equipment
131	Astronomical Geodesics	1513	Optical Images
211	Bibliography	1514	Optical Sensor (s)
311	Camera (s)	1515	Optics
312	Camera Lenses	1611	PERT Project (s)
321	Cartography	1621	Photogrammetry
322	Chart	1622	Photographic Analysis
331	Computer (s)	1623	Photographic Images
332	Computer Program (s)	1624	Photographic Interpretation
333	Computer Programming	1625	Photographic Measurement
341	Conference	1626	Photographic Reconnaissance
351	Contours	1627	Photographic Techniques
361	Coordinate Transformation	1628	Photography
411	Data Processing System (s)	1629	Photo Interpretation
421	Detection	1631	Programming
431	Digital Computer (s)	1711	Quality Control
511	Error (s)	1811	Reconnaissance
611	Film	1812	Reconnaissance Aircraft (Planes)
621	Fortran	1821	Rectifiers (Photographic)
711	Geodesics	1831	Regression Analysis
712	Geodesy	1941	Statistical Probability
713	Geodetic Potition	1951	Surveillance
714	Geodetic Satellite (s)	1961	Surveying
715	Geodetic Surveying	2011	Target Acquisition
721	Graphical Data Processing	2012	Target Recognition
821	Holography	2013	Target (s)
911	IBM	2021	Teaching
921	Imagery	2022	Technical Writing
931	Intelligence	2023	Topography
941	Interferometer (s)	2031	Tracking
1211	Laser (s)	2032	Tracking Stations
1221	Learning Systems	2033	Tracking System (s)
1231	Least Square Methods	2041	Training
1241	Lens	2051	Triangulation

Figure 8

nature of photogrammetry and mapping which crosses many technical fields and has progressed more rapidly than the librarian concept. For example, the subject of Photogrammetric Instrumentation may find application in "Camera Lenses" or "Optical Equipment" or "Photographic Imagery" or "Holography" or other related titles. It may occur under "Physics" or "Interferometers". Photogrammetry is moving rapidly as a science and the reports bring contributions from all allied areas.

For these tests approximately 120 catalogs and publications were reviewed during a period of 18 months. In this time, 320 abstracts were found which related to one of the purposes. None of these were duplicated in the Photogrammetric Engineering journal. This project required a minimum of 20% of the total available time of one trained photogrammetric technician to do a rapid, but not complete, examination. During this time, the list of related categories was revised to include more application to production as well as the technical level. It became apparent as more and more abstracts were identified that the inefficient hunt-and-find system and the extraction and cabinet-type storage of this data would not suffice. It also became evident that there was a continuing supply of new concepts, new techniques, evaluations, reports, etc. which were potentially applicable to the photogrammetrist.

#### AVAILABILITY OF DOCUMENTS:

Much technical and scientific development work is being performed under government or proprietary control and this could limit the rapid accessibility to some information. For example, NASA documents

including their catalog, the STAR (Scientific and Technical Aerospace Reports), are available to:

1. NASA Offices, Centers, Contractors, Subcontractors, Grantees and Consultants
2. Other U.S. Government Agencies and their contractors
3. Libraries that maintain collections of NASA documents for public reference
4. Other organizations having a need for NASA documents in work related to the aerospace program
5. Foreign organizations that exchange publications with NASA or that maintain collections of NASA documents for public use

There are specific procedures to go through to request listed documents and these are included in each catalog. The Technical Abstracts Bulletin (TAB) of the Defense Documentation Center has similar controlled access to its reports. Since a large percentage of photogrammetric application and development is done by or under government agency control, no real problem should exist to the acquisition of documents by a majority of those concerned with these materials. Many reports are not controlled in dissemination and are easily obtainable.

#### INITIAL CONCLUSIONS:

The results of the study show that there is a potential source of information in the system considered, which may be related or applied to

photogrammetry. The study also found that it was not economically feasible to keep up with automated systems of referral and retrieval on an individual, card-file basis even for the single subject of photogrammetry. It was shown that there is a complexity to reviewing technical abstracts which could prohibit the library technician from correlating new developments with organizational needs, due in part to the volume and complexity of the subject or even security restrictions. The study found the concept of a specialized card file of reports or references too large a job for one person to maintain without some form of automation. There is a real need for a specialized listing or breakout of each catalog received, by selected categories, to avoid searching through non-related categories to find the pertinent ones.

The initial study thus ends with a conclusion which could have been assigned a priori. The potential can be exploited adequately only by a further automation of the system by the recipient of the catalogs and reports. To initiate such a system, and certainly there are such systems now in operation elsewhere, the organization's technical information center, technical library, or what ever form of reference facility is used should become more specialized toward the photogrammetrist's needs. These needs should be under the control of a specialist or technician whose sole function is to support the system. An excellent paper has been published by Brian Rothery in the October 1966 issue of Data Processing Magazine on the subject of "The Information Specialist". He recognizes the split between the technical and non-technical. He defines a "new group" to deal with the problem of satisfying the technical and non-technical with some

"startling new tools and devices". This group is geared to specialization and the information explosion.

Given this specialist, the identification of applicable abstract categories would best be served by a selective printout of the developed subjects. This would require a different form of catalog, perhaps on tape or broken out by the abstracting agency. This new catalog could be scanned automatically based on office or department requirements and a composite list of document or report abstracts, regularly updated, furnished to the working personnel. Ordering of the requested reports when abstracts indicate they meet a need can be done through already automated channels (e.g. TELEX). Various sub-libraries could be maintained including photogrammetry. The referral and retrieval facilities of RECON CENTRAL at Wright - Patterson AFB, Ohio are indicative of this specialized library concept. Although RECON CENTRAL specializes in only two areas, reconnaissance and surveillance, they report a file growing at a rate of 1000 documents per month. They offer their specialized service to all qualified requestors, and, as with all referral services, provide bibliography searches by subject, date, etc. of all their holdings.

We have found that it is possible to extract those documents related to the many facets of photogrammetry and create a more current, more usable reference library. We feel that this concept is vital in all phases of the work to avoid "re-inventing the wheel" and to avoid being left behind in the information explosion dust. The ability to review these abstracts is available now to any operator, supervisor or technician if given the time to scan the catalogs. It is a job-related task and one

which certain working areas would find beneficial if they can invest 20% of the available manhours for one qualified person to be their initial specialist. Hopefully, an increased interest and use will create the need for the specialized, automated concept.

The potential of scientific and technical information referral and retrieval is not restricted to the photogrammetrist. It can be expanded to solve problems in other areas. The problem of scientific and technical information to support mapping, charting and geodesy (MC&G) has been recognized at the Department of Defense level. As a result of an investigation, DOD Directive 5105.27 was changed in March 1967 to include a provision for establishing and operating an R&D information system for MC&G. Since then, DOD officials have conducted an intensive study utilizing a group with representatives from DDR&E, DIA and the three military departments. In addition, a contract was let to Data Corporation, who also works with REGON CENTRAL, to help in the program definition for this system.

The STINFO system being established for MC&G is nicknamed "Mapping Central". A data bank is being established which will support management decisions, decisions at the scientist level and will bring the results of R&D programs to the whole MC&G community. It contains the validated DOD R&D requirements for MC&G, the projected programs (DD Form 1498), the status of on-going projects as well as performance specifications and technical reports. This system will also satisfy a requirement laid on DOD by the BOB to keep Federal civil agencies informed on MC&G technology.

The MC&G STINFO Study Group is preparing their final report. The report contains objectives of the system, functions, interface problems with such systems as DDC, ARDIS, NARDIS, etc. The Study Group members



have identified those agencies which will participate in this system with input and output devices which will allow them direct access to the data bank. ACIC has been designated as one of those agencies which will require an input-output channel to the data bank. Thus, the potential of another, large referral and retrieval facility will be readily available. The problem of specialization, selective printouts, etc., defined earlier, will require an automated solution to provide easy accessibility at the working level.

The study which was conducted has demonstrated a potential; a potential of information which certain workers in photogrammetry may not know exists. If, for example, one becomes so concerned with his own day-to-day problems and attempts to maintain his professional status by occasional reading, he may be missing a potential of information directly related to his work.

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D		
(Security Classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION
AERONAUTICAL CHART & INFORMATION CENTER U.S. AIR FORCE, ST. LOUIS, MO. 63118		NONE
		2b. GROUP
		NONE
3. REPORT TITLE		
THE POTENTIAL OF SCIENTIFIC AND TECHNICAL DOCUMENT REFERRAL AND RETRIEVAL TO THE PHOTOGRAMMETRIST		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
FINAL, 1966-1967		
5. AUTHOR(S) (First name, middle initial, last name)		
GENE D. KNIGHT, Supervisory Cartographer, MISSILE SUPPORT DIVISION		
6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
July 1967	15	
8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.		
Not Applicable		
c.		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.		NONE
10. DISTRIBUTION STATEMENT		
This document has been approved for public release and sale; its distribution is unlimited.		
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY
NONE		ACIC, 2nd & Arsenal Sts. St. Louis, Mo. U.S. Air Force
13. ABSTRACT		
<p>Much of the knowledge of photogrammetry will become obsolete in five years. This can be minimized if the photogrammetrist is kept aware of new concepts and advances in scientific and technical fields. Large amounts of scientific and technical reports are being generated by an expanding R&amp;D community. New information, related and applicable to photogrammetry, is becoming continually available. This can aid photogrammetric personnel in keeping abreast of technological advances as well as solving specific problems. Concepts of document referral and retrieval can assist in solving the dilemma of volume, nature and source of new information.</p>		

DD FORM 1 NOV 65 1473

Unclassified

Security Classification

14	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	Cartography Computer Programming Information Referral Information Retrieval Information Theory Information Transfer Mapping Military Technology Photogrammetry Technology Utilization  Suggested Scope Notes  05 BEHAVIORAL & SOCIAL SCIENCES 02 Documentation & Information Tech- nology 08 EARTH SCIENCES AND OCEANOGRAPHY 02 Cartography - Photogrammetry - Mapping 09 ELECTRONICS AND ELECTRICAL ENGINEERING 04 INFORMATION THEORY 14 METHODS & EQUIPMENT 05 Reprography						